Methamphetamine Sampling Variability on Different Surfaces Using Different Solvents

By

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Introduction:

Sampling for methamphetamine on different household surfaces is conducted by a number of individuals for a number of purposes. Researchers have used these sampling techniques to determine the amount of methamphetamine released from the manufacturing process into the environment. Industrial hygienists, realtors, and homeowners frequently utilize surface sampling to determine if a home is contaminated with methamphetamine and how much contamination is present. Remediation contractors may use surface sampling to determine if a home is contaminated, where the home is contaminated, and whether or not the home has been properly remediated. Law enforcement officials may use surface sampling to determine if individuals are contaminated with methamphetamine and whether or not they may need to be decontaminated.

The interpretation of surface sampling results depend upon a number of factors and how the data is to be used. The surface that is wiped may have a significant effect upon the data. A smooth surface that is not porous (metal, glass, painted wood, etc) will generally result in a significant portion of the methamphetamine present being collected in the wipe as opposed to a wipe on a nearby surface that is not smooth. A wipe on a surface that is porous (drywall, clothing, fabric, etc) will not remove as much of the methamphetamine present on the surface and may falsely lead the sampler to believe that methamphetamine surface contamination in the dwelling is low.

In addition to the surface characteristics, the type of solvent used for the wipe may also lead to varied results. A dry wipe will generally result in a much lower result than will a wipe with a solvent. In some cases, a wipe using water may result in a good recovery for the chemical of concern while for other chemicals, an organic solvent may be necessary for the best removal of chemical. Typically, methyl alcohol has been used as a solvent for methamphetamine since it readily dissolves in that solvent. In fact, most methamphetamine solutions that are commercially available are shipped in methanol.

In addition to the solvent and the surface characteristics individually, the combination of the two may also result in different recovery rates. On some surfaces an alcohol solvent may be the best solvent while on others, water may work the best. This project was designed to determine the expected recovery rates for methamphetamine from different surfaces utilizing different solvents.

Methodology:

The purpose of this experiment was to determine the recovery rates for methamphetamine on different surfaces using different solvents that were spiked with a methanol/methamphetamine mixture. This information provided us with the best information regarding recovery rates since it was more controlled than will subsequent portions of the testing conducted using the chamber for methamphetamine exposure. All of the sampled areas had a known amount of contamination measured onto the surface to be sampled.

A known amount of street-cooked methamphetamine was inoculated onto the surface of household materials using a micro-pipette. A total of between 200 ul and 1000 ul of the solution was be applied to each 100 cm^2 surface to be sampled depending upon the characteristics of the surface. For most surfaces 1,000 ul was utilized but for surfaces that were likely to run, lessor amounts were used. The surfaces were outlined on the media to be sampled using a template and a marking pen. The surface was inoculated in a manner that allowed for an even distribution across the surface. After inoculation, the surface was allowed to dry totally, sit for 24 hours, and then sampled.

Samples were taken using sampling media provided by DataChem Laboratories (3"x 3" gauze pads) that were inoculated with 2 ml of the solvent to be used. The pads were wiped in a up and down and then side to side fashion then folded and wiped again in the same manner. This amounted to 4 passes across the area to be sampled. The pads were then inserted into a centrifuge tube and sent to DataChem Laboratories for analysis.

The surfaces used consisted of: drywall, painted drywall, plywood, painted plywood, glass, metal (sheet metal), tile, carpet (short pile), and clothing (cotton). The solvents used were: reagent grade isopropanol, reagent grade methanol, and distilled water. A total of 5 replications were conducted for each spiked surface and 1 replication was collected on an unspiked surface. This resulted in a total of 18 samples for each surface, 5 of which were for each solvent. The 6^{th} sample served as a blank for that material. There were a total of 135 spiked samples, 45 for each of the 3 solvents. There were 27 samples that were unspiked and served as control samples.

The spiking solution was made by dissolving 12 mg of a street-manufactured methamphetamine into a total of 300 ml of reagent grade methanol. Five 1.0 ml samples of the spiking solution were sent to the laboratory for analysis and it was determined that each 1.0 ml of the spiking solution contained 27 ug of the street-grade methamphetamine. Street-grade methamphetamine was utilized since it provided a real-world test over pure methamphetamine obtained from Sigma Chemical.

Results:

At the spiking level of 27 ug/ml of spiking solution, all but two of the samples returned a positive result. In addition, all of the blanks that were taken resulted in a negative result indicating that cross-contamination from the sample taking and false positives from the laboratory were not likely. The surfaces sampled and the recovery of methamphetamine from those surfaces were as follows:

Surface Type	*Mean Recovery (%)*	*Median Recovery (%)*	*Minimum Recovery (%)*	*Maximum Recovery (%)*
Unpainted Drywall	0.93%	0.41%	0.23%	2.48%
Painted Drywall	73.75%	70.37%	24.81%	103.7%
Unpainted Plywood	5.79%	5.19%	2.48%	10.74%
Painted Plywood	74.32%	77.78%	48.15%	92.59%
Glass	53.33%	53.33%	22.22%	81.48%
Metal	90.07%	91.85%	68.15%	111.11%
Tile	11.55%	8.89%	0.59%	38.52%
Carpeting (Short Pile)	1.31%	1.30%	0.63%	2.70%
Clothing (Jeans)	0.42%	0.37%	0.21%	0.78%

The highest level of return was found for the metal samples. This was somewhat of a surprise since glass was expected to be the highest level of return however, it appears that glass allowed the moving around of the methamphetamine and resulted in a lower return. The lowest return was found for clothing followed by unpainted drywall and carpeting. All of these materials are very porous and did not release the inoculated methamphetamine easily. Sampling these surfaces would result in much lower methamphetamine levels than were actually present on the material.

Unpainted plywood was also found to yield only 6% of the spiked methamphetamine back upon wiping the surface. The tile used was a relatively smooth tile, yet it also released less than 12% of the methamphetamine that had been spiked onto the surface. The painted materials, glass and metal resulted in the highest recovery for the methamphetamine, with metal releasing over 90% of the methamphetamine.

The different solvents also had different levels of recovery. The results of the solvent tests were as follows:

Solvent	*Mean Recovery (%)*	*Median Recovery (%)*	*Minimum Recovery (%)*	*Maximum Recovery (%)*
Isopropanol	35.72 %	12.59 %	0.22 %	103.70 %
Methanol	30.24 %	18.52 %	0 %	82.96 %
Water	37.85 %	8.52 %	0 %	111.11 %

These results show that none of the different solvents utilized were significantly better than any of the others. Although the methanol had the best median recovery, it was not much higher than isopropanol. Even water was found to be fairly good generally for all of the surfaces. When we compared the results by the type of media that was tested, we found the following:

Surface Type	*Isopropanol Mean Recovery (%)*	*Methanol Mean Recovery (%)*	*Water Mean Recovery (%)*	*Average Mean Recovery (%)*
Unpainted Drywall	0.4%	0.4%	**2.0%**	0.93%
Painted Drywall	**94.8%**	53.9%	72.6%	73.8%
Unpainted Plywood	5.1%	3.5%	**8.7%**	10.74%
Painted Plywood	**88.1%**	64.4%	70.4%	74.3%
Glass	32.0%	50.8%	**77.2%**	53.3%
Metal	88.0%	76.4%	**105.8%**	90.1%
Tile	12.0%	**21.2%**	1.4%	11.6%
Carpeting (Short Pile)	0.7%	1.2%	**2.0%**	1.3%
Clothing (Jeans)	0.3%	0.3%	**0.6%**	0.4%

These data suggest that specific solvents may be better for specific surfaces. Isopropanol appeared to be better for painted surfaces while water seemed to be better for unpainted surfaces and glass. Methanol yielded better results for tile surfaces and was in between for some of the other surfaces. In general, no solvent was best for all surfaces.

Discussion and Conclusions:

This study sheds light on five issues that become important when evaluating a structure for methamphetamine contamination:

1. Which surfaces within the structure should be sampled in order to determine if the structure has been used to smoke or manufacture methamphetamine?

2. What solvents should be used in the wipe in order to obtain the best data available?

3. What do the results obtained from wipe sampling mean when evaluating a structure for use or manufacture of methamphetamine?

4. How adequately do wipe samples reflect the amount of methamphetamine present within a structure?

5. How easily will methamphetamine transfer from surfaces in a structure to individuals coming into contact with those surfaces?

In regards to the first question, our research suggests that the surfaces sampled will have a very large impact upon the amount of methamphetamine that will be recovered from that surface. Porous surfaces such as unpainted drywall, unpainted wood, carpeting, and clothing will have very poor recovery of any methamphetamine present. Recovery rates will be less than 10% and, in many cases, less than 1%, regardless of the solvents utilized. Therefore, if these surfaces are sampled to determine methamphetamine contamination levels, even low levels of methamphetamine should suggest much higher contamination than would samples taken on non-porous surfaces. The best surfaces for evaluation will be smooth, non-porous surfaces. These surfaces resulted in recovery rates of 50% or better, in most cases. Tile surfaces provided relatively lower recovery levels (< 12%) due to some porosity in the tiles.

Our research did not reveal a specific solvent that was best to use for all surfaces. All of the solvents seemed to perform equally in our project. Several other studies have suggested that methanol is the best solvent to utilize and, in fact, methamphetamine is normally supplied by laboratory supply companies suspended in a methanol solution. We believe that the best solvent to use is the solvent suggested by the laboratory that is conducting the analysis. The combination of sampling media and solvent in general use by that laboratory is usually the best choice.

The results of any wipe sampling can be interpreted differently by different individuals. Our research indicates that the samples that best reflect the contamination level within the structure will be taken from smooth, non-porous surfaces. Samples taken from painted wood or drywall will likely result in a recovery rate that is above 70% of the methamphetamine present. Samples taken from metal surfaces may allow as much as a 90% recovery of methamphetamine present on the surface. These surfaces should result in the best evaluation of the contamination present. However, these surfaces are also the surfaces that are the easiest to clean and they may suggest a low contamination level even

though the porous surfaces are heavily contaminated. This is most likely to occur in homes that have been inadequately cleaned. If samples from porous surfaces reveal elevated methamphetamine levels, the total contamination on that surface may be much higher (10 times or more). Therefore, unexpectedly high levels from porous materials should signal a need for different samples, possibly bulk carpet and clothing samples.

The fact that porous materials do not allow for high recovery of the methamphetamine present, may also suggest that methamphetamine will not easily be transferred from those materials. Methamphetamine in unpainted drywall or unpainted wood may not easily be transferred from that surface to other surfaces or onto humans that come into contact with those surfaces. Simply sitting on a chair in a methamphetamine-contaminated house may not impart much methamphetamine to the clothing of the individuals sitting on the chair. If vigorous wiping only results in a 1% transfer to the wipe, simply coming into contact with that surface should not result in much transfer at all. Carpeting may be somewhat of a different condition since vacuuming has been shown to result in a re-suspension of the methamphetamine from the carpeting.

Study Limitations:

This study is somewhat limited in how the methamphetamine was applied to the surfaces to be sampled. Since the methamphetamine was applied using a solution of methamphetamine using a micropipette, the methamphetamine may have had a deeper penetration into clothing, wood, and drywall than if it had been put there as an aerosol. We believe that this difference was not likely to generate different results for non-porous materials but may be different for the porous materials. It is likely the most different for carpeting since the methamphetamine contamination in carpeting may reside on dust and on the surface of the material under normal contamination scenarios. These differences will be explored in future research when actual aerosol methodologies are utilized.

A second difference in our methodology was the use of a street-manufactured drug. We conducted the experiment using this methodology because we wanted to mimic actual conditions and not conditions using a laboratory-grade methamphetamine. It is possible that street-grade methamphetamine may behave differently than laboratory grade methamphetamine and we may be able to look at that in the future. The value of that comparison may not be great since most methamphetamine contamination in structures is caused by street-grade and not laboratory-grade methamphetamine.

Samples Collected and Results:

The following chart lists all of the samples taken and the individual results of those samples:

Methamphetamine Recovery Project

Sample #	Surface	Solvent	Area	ug predicted	ug obtained	% recovery
1	Unpainted Drywall	isopropanol	100 cm^2	27	0.067	0.2
2	Unpainted Drywall	isopropanol	100 cm^2	27	0.089	0.3
3	Unpainted Drywall	isopropanol	100 cm^2	27	0.096	0.4
4	Unpainted Drywall	isopropanol	100 cm^2	27	0.096	0.4
5	Unpainted Drywall	isopropanol	100 cm^2	27	0.16	0.6
6	Unpainted Drywall	isopropanol	100 cm^2	Blank	ND	NA
7	Unpainted Drywall	methanol	100 cm^2	27	0.063	0.2
8	Unpainted Drywall	methanol	100 cm^2	27	0.18	0.7
9	Unpainted Drywall	methanol	100 cm^2	27	0.083	0.3
10	Unpainted Drywall	methanol	100 cm^2	27	0.066	0.2
11	Unpainted Drywall	methanol	100 cm^2	27	0.11	0.4
12	Unpainted Drywall	methanol	100 cm^2	Blank	ND	NA
13	Unpainted Drywall	water	100 cm^2	27	0.43	1.6
14	Unpainted Drywall	water	100 cm^2	27	0.67	2.5
15	Unpainted Drywall	water	100 cm^2	27	0.59	2.2
16	Unpainted Drywall	water	100 cm^2	27	0.65	2.4
17	Unpainted Drywall	water	100 cm^2	27	0.4	1.5
18	Unpainted Drywall	water	100 cm^2	Blank	ND	NA
19	Painted Drywall	isopropanol	100 cm^2	27	25	92.6
20	Painted Drywall	isopropanol	100 cm^2	27	26	96.3
21	Painted Drywall	isopropanol	100 cm^2	27	28	103.7
22	Painted Drywall	isopropanol	100 cm^2	27	27	100.0
23	Painted Drywall	isopropanol	100 cm^2	27	22	81.5
24	Painted Drywall	isopropanol	100 cm^2	Blank	ND	NA
25	Painted Drywall	methanol	100 cm^2	27	6.7	24.8
26	Painted Drywall	methanol	100 cm^2	27	18	66.7
27	Painted Drywall	methanol	100 cm^2	27	17	63.0
28	Painted Drywall	methanol	100 cm^2	27	17	63.0
29	Painted Drywall	methanol	100 cm^2	27	14	51.9
30	Painted Drywall	methanol	100 cm^2	Blank	ND	NA
31	Painted Drywall	water	100 cm^2	27	21	77.8
32	Painted Drywall	water	100 cm^2	27	19	70.4
33	Painted Drywall	water	100 cm^2	27	19	70.4
34	Painted Drywall	water	100 cm^2	27	20	74.1
35	Painted Drywall	water	100 cm^2	27	19	70.4
36	Painted Drywall	water	100 cm^2	Blank	ND	NA
37	Unpainted plywood	isopropanol	100 cm^2	27	1.1	4.1
38	Unpainted	isopropanol	100 cm^2	27	1.4	5.2

	plywood						
39	Unpainted plywood	isopropanol	100 cm^2		27	1.7	6.3
40	Unpainted plywood	isopropanol	100 cm^2		27	1.5	5.6
41	Unpainted plywood	isopropanol	100 cm^2		27	1.2	4.4
42	Unpainted plywood	isopropanol	100 cm^2	Blank	ND		NA
43	Unpainted plywood	methanol	100 cm^2		27	1.2	4.4
44	Unpainted plywood	methanol	100 cm^2		27	1.2	4.4
45	Unpainted plywood	methanol	100 cm^2		27	0.67	2.5
46	Unpainted plywood	methanol	100 cm^2		27	0.8	3.0
47	Unpainted plywood	methanol	100 cm^2		27	0.89	3.3
48	Unpainted plywood	methanol	100 cm^2	Blank	ND		NA
49	Unpainted plywood	water	100 cm^2		27	2.3	8.5
50	Unpainted plywood	water	100 cm^2		27	1.9	7.0
51	Unpainted plywood	water	100 cm^2		27	2.5	9.3
52	Unpainted plywood	water	100 cm^2		27	2.2	8.1
53	Unpainted plywood	water	100 cm^2		27	2.9	10.7
54	Unpainted plywood	water	100 cm^2	Blank	ND		NA
55	Painted Plywood	isopropanol	100 cm^2		27	23	85.2
56	Painted Plywood	isopropanol	100 cm^2		27	23	85.2
57	Painted Plywood	isopropanol	100 cm^2		27	25	92.6
58	Painted Plywood	isopropanol	100 cm^2		27	25	92.6
59	Painted Plywood	isopropanol	100 cm^2		27	23	85.2
60	Painted Plywood	isopropanol	100 cm^2	Blank	ND		NA
61	Painted Plywood	methanol	100 cm^2		27	19	70.4
62	Painted Plywood	methanol	100 cm^2		27	18	66.7
63	Painted Plywood	methanol	100 cm^2		27	15	55.6
64	Painted Plywood	methanol	100 cm^2		27	16	59.3
65	Painted Plywood	methanol	100 cm^2		27	19	70.4

66	Painted Plywood	methanol	100 cm^2	Blank	ND		NA
67	Painted Plywood	water	100 cm^2	27	21		77.8
68	Painted Plywood	water	100 cm^2	27	18		66.7
69	Painted Plywood	water	100 cm^2	27	21		77.8
70	Painted Plywood	water	100 cm^2	27	22		81.5
71	Painted Plywood	water	100 cm^2	27	13		48.1
72	Painted Plywood	water	100 cm^2	Blank	ND		NA
73	Glass	isopropanol	100 cm^2	13.5	3.5		25.9
74	Glass	isopropanol	100 cm^2	13.5	4.1		30.4
75	Glass	isopropanol	100 cm^2	13.5	6.1		45.2
76	Glass	isopropanol	100 cm^2	13.5	3		22.2
77	Glass	isopropanol	100 cm^2	13.5	4.9		36.3
78	Glass	isopropanol	100 cm^2	Blank	ND		NA
79	Glass	methanol	100 cm^2	13.5	3.5		25.9
80	Glass	methanol	100 cm^2	13.5	6.5		48.1
81	Glass	methanol	100 cm^2	13.5	8.1		60.0
82	Glass	methanol	100 cm^2	13.5	9		66.7
83	Glass	methanol	100 cm^2	13.5	7.2		53.3
84	Glass	methanol	100 cm^2	Blank	ND		NA
85	Glass	water	100 cm^2	13.5	9.3		68.9
86	Glass	water	100 cm^2	13.5	9.8		72.6
87	Glass	water	100 cm^2	13.5	11		81.5
88	Glass	water	100 cm^2	13.5	11		81.5
89	Glass	water	100 cm^2	13.5	11		81.5
90	Glass	water	100 cm^2	Blank	ND		NA
91	Metal	isopropanol	100 cm^2	6.75	6.9		102.2
92	Metal	isopropanol	100 cm^2	6.75	6.2		91.9
93	Metal	isopropanol	100 cm^2	6.75	6.5		96.3
94	Metal	isopropanol	100 cm^2	6.75	5.5		81.5
95	Metal	isopropanol	100 cm^2	6.75	4.6		68.1
96	Metal	isopropanol	100 cm^2	Blank	ND		NA
97	Metal	methanol	100 cm^2	6.75	5.6		83.0
98	Metal	methanol	100 cm^2	6.75	5.4		80.0
99	Metal	methanol	100 cm^2	6.75	5		74.1
100	Metal	methanol	100 cm^2	6.75	5.2		77.0
101	Metal	methanol	100 cm^2	6.75	4.6		68.1
102	Metal	methanol	100 cm^2	Blank	ND		NA
103	Metal	water	100 cm^2	6.75	6.6		97.8
104	Metal	water	100 cm^2	6.75	7.2		106.7
105	Metal	water	100 cm^2	6.75	7.2		106.7
106	Metal	water	100 cm^2	6.75	7.5		111.1
107	Metal	water	100 cm^2	6.75	7.2		106.7
108	Metal	water	100 cm^2	Blank	ND		NA
109	Tile	isopropanol	100 cm^2	13.5	1.6		11.9

110	Tile	isopropanol	100 cm^2		13.5	1.8	13.3
111	Tile	isopropanol	100 cm^2		13.5	1.2	8.9
112	Tile	isopropanol	100 cm^2		13.5	1.8	13.3
113	Tile	isopropanol	100 cm^2		13.5	1.7	12.6
114	Tile	isopropanol	100 cm^2	Blank		ND	NA
115	Tile	methanol	100 cm^2		13.5	0.84	6.2
116	Tile	methanol	100 cm^2		13.5	1.2	8.9
117	Tile	methanol	100 cm^2		13.5	5.2	38.5
118	Tile	methanol	100 cm^2		13.5	2.5	18.5
119	Tile	methanol	100 cm^2		13.5	4.6	34.1
120	Tile	methanol	100 cm^2	Blank		ND	NA
121	Tile	water	100 cm^2		13.5	0.13	1.0
122	Tile	water	100 cm^2		13.5	0.17	1.3
123	Tile	water	100 cm^2		13.5	0.08	0.6
124	Tile	water	100 cm^2		13.5	ND	NA
125	Tile	water	100 cm^2		13.5	0.47	3.5
126	Tile	water	100 cm^2	Blank		ND	NA
127	Carpet	isopropanol	100 cm^2		27	0.2	0.7
128	Carpet	isopropanol	100 cm^2		27	0.2	0.7
129	Carpet	isopropanol	100 cm^2		27	0.17	0.6
130	Carpet	isopropanol	100 cm^2		27	0.19	0.7
131	Carpet	isopropanol	100 cm^2		27	0.18	0.7
132	Carpet	isopropanol	100 cm^2	Blank		ND	NA
133	Carpet	methanol	100 cm^2		27	0.36	1.3
134	Carpet	methanol	100 cm^2		27	0.25	0.9
135	Carpet	methanol	100 cm^2		27	0.39	1.4
136	Carpet	methanol	100 cm^2		27	0.35	1.3
137	Carpet	methanol	100 cm^2		27	0.27	1.0
138	Carpet	methanol	100 cm^2	Blank		ND	NA
139	Carpet	water	100 cm^2		27	0.44	1.6
140	Carpet	water	100 cm^2		27	0.49	1.8
141	Carpet	water	100 cm^2		27	0.53	2.0
142	Carpet	water	100 cm^2		27	0.54	2.0
143	Carpet	water	100 cm^2		27	0.73	2.7
144	Carpet	water	100 cm^2	Blank		ND	NA
145	Clothing	isopropanol	100 cm^2		27	0.074	0.3
146	Clothing	isopropanol	100 cm^2		27	0.099	0.4
147	Clothing	isopropanol	100 cm^2		27	0.11	0.4
148	Clothing	isopropanol	100 cm^2		27	0.1	0.4
149	Clothing	isopropanol	100 cm^2		27	0.059	0.2
150	Clothing	isopropanol	100 cm^2	Blank		ND	NA
151	Clothing	methanol	100 cm^2		27		NA
152	Clothing	methanol	100 cm^2		27	0.066	0.2
153	Clothing	methanol	100 cm^2		27	0.1	0.4

154	Clothing	methanol	100 cm^2		27	0.092	0.3
155	Clothing	methanol	100 cm^2		27	0.058	0.2
156	Clothing	methanol	100 cm^2	Blank		ND	NA
157	Clothing	water	100 cm^2		27	0.18	0.7
158	Clothing	water	100 cm^2		27	0.17	0.6
159	Clothing	water	100 cm^2		27	0.13	0.5
160	Clothing	water	100 cm^2		27	0.16	0.6
161	Clothing	water	100 cm^2		27	0.21	0.8
162	Clothing	water	100 cm^2	Blank		ND	NA
163	Spike Sample	NA	NA		27	29	107.4
164	Spike Sample	NA	NA		27	25	92.6
165	Spike Sample	NA	NA		27	28	103.7
166	Spike Sample	NA	NA		27	26	96.3
167	Spike Sample	NA	NA		27	27	100.0

ND = Non-detect
NA = Not applicable